

Role of needles in close-range host selection by the white pine weevil on Sitka spruce

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ABSTRACT

The white pine weevil, *Pissodes strobi* Peck, is apparently induced to feed and oviposit on the cortex of leaders of Sitka spruce, *Picea sitchensis* (Bong.) Carr, in part through the influence of needles. In laboratory feeding bioassays, mature needles were shown to contain non-volatile feeding deterrents, which probably direct weevils away from them to feed on the bark. In addition, weevils fed more frequently on agar bark discs with spruce needles or toothpicks inserted in them than on control discs, suggesting that the needles have a positive thigmatactic effect on close range host selection.

INTRODUCTION

Stands of Sitka spruce, *Picea sitchensis* (Bong.) Carr (Silver 1968), Englemann spruce, *Picea engelmanni* Parry (Stevenson 1967), and eastern white pine, *Pinus strobus* L. (Belyea and Sullivan 1956) are seriously plagued by attacks of the white pine weevil, *Pissodes strobi* Peck. In the spring, the weevils apparently orient visually to the terminal leader of the tree (VanderSar and Borden 1977a). They are induced to feed on the bark by chemical stimulants (VanderSar and Borden 1977b; Alfaro *et al.* 1980), and feed and oviposit in the one-year-old leader directly below the apical bud cluster (Silver 1968). Although the needles contain some cuticular feeding stimulants (Alfaro *et al.* 1980), no feeding has been observed on them. However, leaders with sparse needle growth are less often attacked than those with high needle density (unpublished observation). The weevils find the terminal bud through positive phototaxis and negative geotaxis (VanderSar and Borden 1977c), but the precise mechanisms by which the weevils orient to the bark on one-year-old branches for feeding and on leaders for feeding and oviposition, while avoiding other sites, are unknown. Our objective was to investigate the role of Sitka spruce needles in regulating feeding activity by *P. strobi*.

MATERIALS AND METHODS

Terminal leaders of Sitka spruce containing mature *P. strobi* larvae were collected from Nootka Island and Vancouver Island and stored, until required, in a cold room at 2°C for up to 4 months. Weevils emerged at room temperature in cages, and were maintained at 4°C on a modified diet (Zerillo and Odell 1973). Some adult weevils were also collected in the spring from plantations in the University of British Columbia Forest, Maple Ridge, B.C. All Sitka spruce samples were collected from sapling trees at the U.B.C. Research Forest or Harrison Hot Springs in the lower mainland of British Columbia. They were stored at 5°C until used.

Laboratory experiments employed the feeding bioassay developed by Alfaro *et al.* (1979). Single or paired agar discs containing the candidate stimuli were covered with lens paper, and set in paraffin wax in petri dishes. The number of feeding punctures made by weevils in the lens paper indicated the amount of feeding activity in response to the stimulus incorporated in the agar. Each replicate (dish), containing three weevils, was placed on a counter-top at room temperature and constant light. As weevils of either sex

feed similarly (VanderSar and Borden 1977b), no distinction was made as to the sex of the weevils used.

To test for possible feeding deterrents in the needles, single agar disc treatments were prepared. A control treatment contained 1% dried and ground Sitka spruce bark while experimental treatments contained, in addition to 1% bark, dried and ground Sitka spruce needles from the leader. These were incorporated at concentrations of 0.1, 1.0, 2.5 and 10% into the agar. Each treatment was tested for 8 h and had 15 replicates.

The physical effect of needles on feeding activity was assessed by two paired experiments with all agar discs containing 1% dried bark. Mature needles were cut from lateral branches and their cut ends were sealed by dipping in paraffin wax. In the first experiment, one agar disc had three needles inserted into the agar perpendicular to the surface, while the other disc had no needles. The second experiment had one disc with three inserted needles and one with three inserted toothpicks, cut to needle length. Initially there were 20 replicates in each 40 h experiment, but replicates in which weevils did not feed at all (four in the first, and one in the second experiment) were deleted. Paired means in each experiment were compared by *t* tests, $\alpha = 0.05$.

RESULTS AND DISCUSSION

When the weevils were given a choice between Sitka spruce bark agar discs and those with needle powder added, there was a pronounced deterrent effect of the needles, especially at higher concentrations (Fig. 1). Thus non-volatile feeding deterrents in the needles appear to override the effect of weak, cuticular feeding stimulants (Alfaro *et al.*

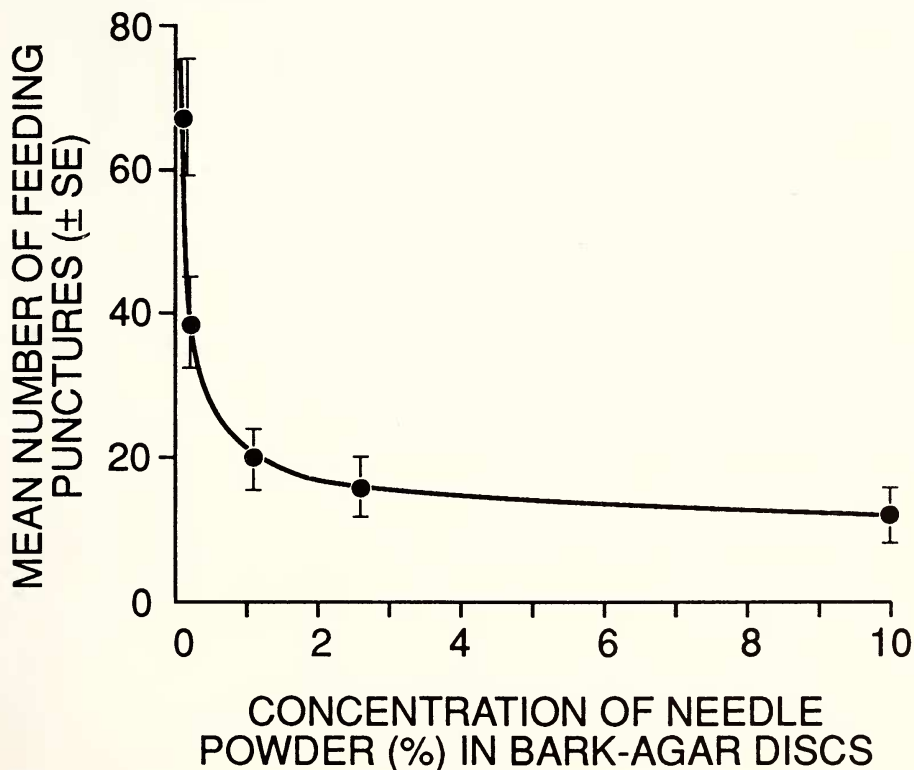


Fig. 1. Feeding response of *P. strobi* to Sitka spruce bark agar discs containing increasing amounts of Sitka spruce needle powder. Curve fitted by hand.

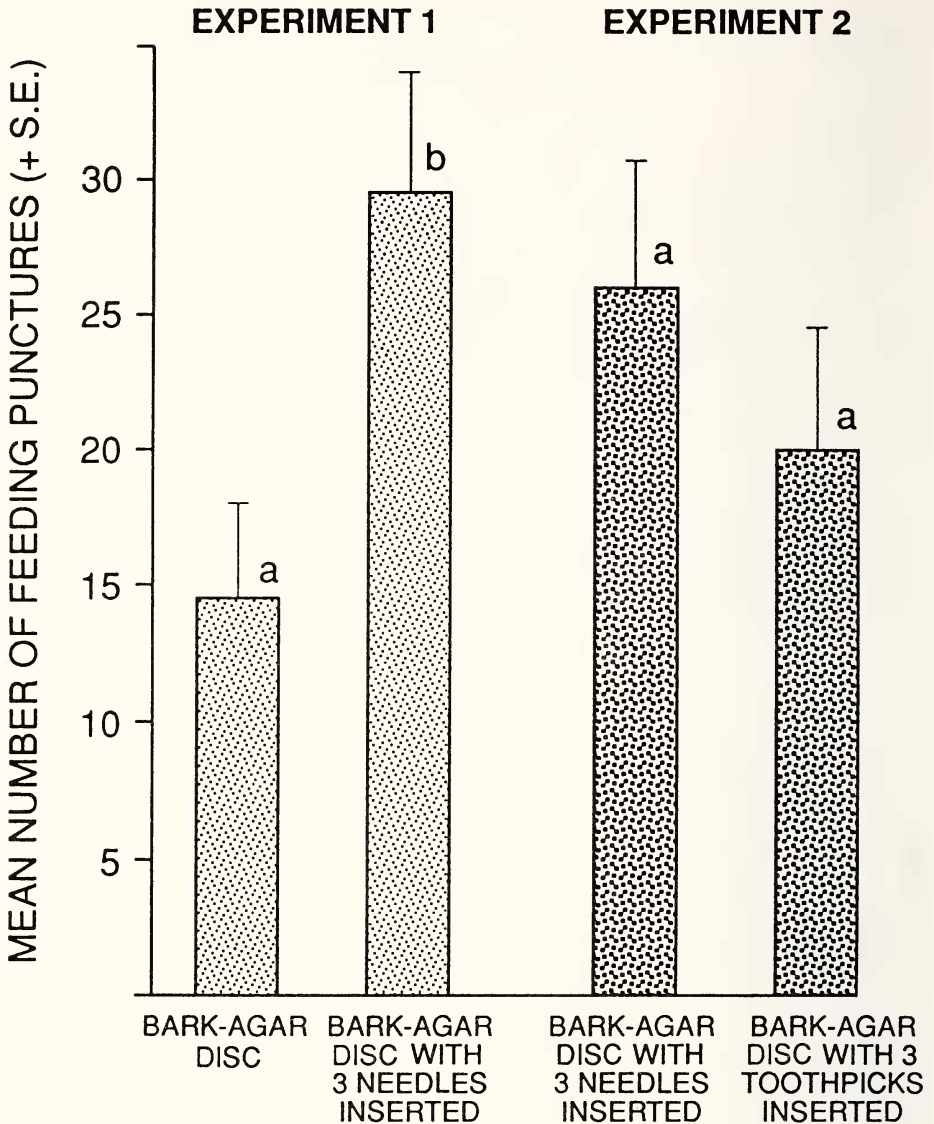


Fig. 2. Feeding response of *P. strobi* to Sitka spruce bark agar discs in the presence of spruce needles or toothpicks. Bars topped by the same letter are not significantly different, *t* test, $P < 0.05$.

1980), and may in part direct the weevils away from the needles towards the appropriate site for feeding and oviposition, i.e. the bark surface.

Vertically implanted needles in Sitka spruce bark agar discs significantly increased feeding by weevils (Fig. 2). The weevils did not discriminate between Sitka spruce needles and plain toothpicks inserted into the agar. They were observed to feed preferentially while touching the needles or toothpicks, suggesting that there is a thigmotactic response.

A thigmotactic requirement also occurs in the smaller European elm bark beetle, *Scolytus multistriatus* (Marsham), which feeds in the crotch of elm twigs (Peacock *et al.* 1967). The hypothesis for a thigmotaxis is supported by our field observations that the majority of feeding weevils are found in direct contact with needles. This behavior may be of adaptive advantage to the weevils, as the needles may provide concealment or physical protection from predators such as birds.

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Efficacy of deltamethrin and *Bacillus thuringiensis* Berliner ssp *kurstaki* on larvae of winter moth, *Operophtera brumata* (L.) (Lepidoptera: Geometridae) attacking blueberry in the Lower Mainland of British Columbia

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ABSTRACT

Two pesticides were evaluated for control of the European winter moth, *Operophtera brumata* (L.), in blueberries in Richmond, British Columbia. The pyrethroid, deltamethrin (Decis), was effective against this pest. The *Bacillus thuringiensis* product Dipel (WP) was ineffective. Deltamethrin provides an alternative to the currently used organo-phosphate pesticides.

INTRODUCTION

The European winter moth, *Operophtera brumata* (L.), was first introduced to the east coast of North America (Nova Scotia) as early as the 1930s (Cuming 1961, Embree 1965, 1970), and to southern Vancouver Island (Victoria, British Columbia) prior to 1970 (Gillespie *et al.* 1978, Roland 1988). Since then, the winter moth has spread to the mainland of British Columbia and is most prevalent in the southwestern communities of Ladner, Tsawwassen and Richmond.